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Technical Report No. 6201

DESIGN OF AN OPTICAL INSERT, TYPE 2, FOR THE TANK
CBR PROTECTIVE MASK (E56R3)

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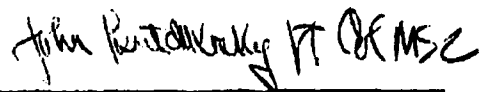
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A B S T R A C T

An optical insert has been developed for the Tanker's CBR Protective Mask. This insert incorporates many features of ordinary spectacles, and may be fitted to tank crew personnel who require visual correction.

The insert comprises an assembled component which is supported in the mask by inserting the temporal struts of the insert into a series of holes in the two rubber protrusions molded to the inner sides of the eyepiece channel of the mask faceblank.

I. INTRODUCTION

The requirement for this project was the result of an investigation by the U. S. Armor Board who determined the need for corrective lenses for tank crewmen. Because of this laboratory's previous experience in developing the Optical Insert, Type I, for the Military Protective Mask (M17), and in an effort to insure maximum continuity of design, this laboratory was directed in September 1960, by the U. S. Army Medical Research and Development Command to undertake this project.

II. DESIGN STUDIES

Preliminary planning for this project was initiated after receipt of four (4) Tanker's CBR Protective Masks, engineering drawings and other related data from the U. S. Army Chemical Research and Development Laboratories, Army Chemical Center, Edgewood, Maryland.

In an effort to maintain maximum continuity of design the binocular-lens assembly without temporal struts, developed for the Optical Insert, Type I, M17 CBR Military Protective Mask, was evaluated for use in this type of mask and found to be satisfactory. This assembly comprised two eye wires and bridge blocks connected by a helical spring bridge.

To utilize the assembly in the tanker's protective mask the faceblank and eyepiece assembly and particularly the region surrounding the eyepiece, were examined for a possible method of securing the binocular lens assembly to the mask.

The assembly is comprised of the faceblank of molded rubber and the eyepiece. A large, flexible, clear plastic is cemented into the eyepiece channel molded in the faceblank. The faceblank has molded to its exterior surface a stem for the outlet valve, an inlet stem, a cable stem, four pads at the cheek and temple areas, and two straps at the forehead area for buckle attachments for a head harness.

This assembly of the mask offered only one region that could be considered as an attachment point for an optical insert support which would not require modification of the faceblank molds, namely, the temple pads molded to the mask and used for riveting the buckle attachments for the head harness to the faceblank.

The design consideration was to use special rivets that would allow optical insert supports to be fastened to them; however, this design was found to be unsatisfactory due to pressure on the temples of the mask wearer.

Discussions with representatives of the U. S. Army Chemical Research and Development Laboratories resulted in agreement that the mask did not lend itself to any method of supporting an optical insert without minor modifications to the faceblank.

Further design studies indicated the possibility of supporting the insert by utilizing a polyethylene strap fastened to the mask in the central forehead region by means of nylon collar-button fasteners, similar to those used to secure the nose cup in the mask. The strap would extend from the forehead to the bridge of the nose, following the interior surface of the mask. To hold the insert in position the strap would widen at the bridge and a hole slotted along its length and running in a horizontal plane would be provided to receive the bridge of the insert.

A prototype of this design was fabricated and installed in a mask. Laboratory evaluation of this design disclosed that the insert could not be adequately stabilized by this type of support.

Continued study of the design of an optical insert for the tank's mask pointed to a need for more detailed information on the environment of tank crewmen when they are performing their duties within the tank.

It was also necessary to have a more thorough understanding of the amount of protection provided to the crewman's head (temporal region) when the protective mask is worn with the combat vehicle crewman's (CVC) protective helmet. Also, information was needed that would determine the amount of distortion to the eyepiece of the protective mask when crewmen used optical instruments installed in the tank for firecontrol (M-20 periscope, M-97 telescope) and monocular or binocular range finders.

To resolve these problems and others encountered during design studies, arrangements were made with the U. S. Army Ordnance Human Engineering Laboratories, Aberdeen Proving Grounds, Aberdeen, Maryland, to visit their facility. The Human Engineering Laboratories are concerned with the man-machine interactions involved in the operation and maintenance of ordnance equipment.

The data obtained resulted in the determination that the combat vehicle crewman's (CVC) protective helmet would provide adequate protection to the temple region and, further, that the distortion of the eyepiece in this same region would not affect adversely the utilization of the inner sides of the eyepiece channel in the temporal region as a location for the binocular lens assembly anchor point.

Basic visual data was used to establish the angular planes necessary to locate a supporting block in the temporal region. The supporting block would be capable of firmly supporting the insert within the mask and also permit positioning of the insert relative to the wearer's eyes, so that accurate visual corrections could be maintained when using the mask-insert combination.

The design of the supporting block was initiated after determining the binocular lens assembly would be adequately stabilized in the mask by attaching the two (2) struts to each eye wire in the temple area. One strut on each eye wire would be attached 3 mm. above the major horizontal axis of the binocular lens assembly; the other strut would be attached 3 mm. below this axis.

As discussed previously, the binocular lens assembly that was developed for the M17 CBR Protective Mask would be incorporated in the design of an insert for the tanker's mask for the following reasons:

1. Optical Characteristics
2. Compatibility with the mask
3. Continuity of design

An anthropometric model of a medium adult male head and a medium size CBR Protective Mask (E56R3) were furnished to this laboratory by the U. S. Army Chemical Research and Development Laboratories. These were utilized as a combination standard for developing the optical insert support block.

On the temporal-orbital region of the head, plastilene build-ups were formed that filled in the inner side of the face-piece channel of the mask.

To determine the correct position of holes that would act as receptacles for the dual struts attached to the binocular-lens assembly, a portion of the eyepiece of the mask was removed. The

removal of this section did not lessen the structural rigidity of the mask, therefore the mask retained its natural shape and fit on the head mold. Its removal permitted the prototype insert to be positioned inside the mask in the proper visual attitude without disturbing the head/mask relationship.

From these studies a block of rectangular shape was designed that protruded from the inner temporal eyepiece channel of the mask; this protrusion was provided with five (5) holes that would permit horizontal adjustment of the insert.

III. DESIGN

Data accumulated during design studies conducted on this project resulted in the development of a prototype optical insert and a method for supporting this insert in the E56R3 Tanker's Protective Mask (CBR).

A. The optical insert comprises the following parts assembled in a unit:

The eyewires, formed of rolled eyewire stock, are adequately grooved to hold beveled ophthalmic lenses. They are modified oval shape and have sufficiently large radii to prevent chipping of the corrective ophthalmic glass lenses when they are being edged. This shape will also allow faster production, eliminate problems of highpower lens insertions and reduce breakage.

The eyewire screw clamps are located on the lower section of the eyewires in the geometric center, and permit the insertion or removal of corrective ophthalmic glass lenses from the eyewire.

The bridge blocks are attached to the eyewires so that the lower faces of the blocks lie on the geometric horizontal center line of the insert.

The bridge that is attached to the bridge blocks is a close-coiled helical spring that will permit the insert, while still positioned in the mask, to be folded with the mask and placed in its carrier when not in use.

A pair of temporal struts are attached to each eyewire 6 mm. between center lines. Two struts are provided for maximum stability of the insert in the mask.

The optical insert designed for this mask will be stocked in two bridge widths: 22 mm. (narrow) and 26 mm. (wide). This distance is measured from the nasal faces of the bridge blocks. These bridge widths will provide inserts that have mechanical interpupillary distances of 64 mm. and 68 mm. Optical decentration of the lenses may be utilized to fit a complete range of interpupillary measurements.

B. The support for the optical insert holds the insert firmly in position in the mask. The support must also be capable of permitting the insert to be properly aligned in relation to a plane running horizontally through the pupils of the wearer's eyes. This was accomplished by bonding a rectangular rubber block approximately 1/4" thick, 5/8" high, and of sufficient length to fill in the channel formed for the eye lens of the mask and blending it into the temporal sides of the faceblank. This block contained five (5) holes 1/16" diameter, 1/2" deep, and spaced 3mm. apart on a vertical plane. Later a block containing seven (7) holes, for a greater range of adjustment, was molded in the faceblank at U. S. Army Chemical Research and Development Laboratories.

Prior to fitting the insert the mask is donned in the conventional manner and properly oriented on the head, then by directing the wearer's gaze straight ahead, a horizontal plane is established which will pass through the pupils of the wearer's eyes and through holes in the support block. When this plane has been established the insert dual temples are "plugged" into the holes above and the holes below the holes in the support block established as "on line" with the wearer's pupils. This will position the approximate geometric centers of the insert lenses into correct relation to the pupils of the wearer's eyes.

The holes in the support block are smaller in diameter (.062) than those of the temporal struts, (.080), therefore, when the struts are "plugged" into the support blocks, they are firmly gripped by the compression of the rubber. This gripping action not only provides excellent stability of the insert but will also permit accurate control of the vertex distance calculated for ordinary spectacles.

C. The following design criteria for the tanker's optical insert were established as a result of design studies.

1. The insert design will incorporate the binocular-lens assembly of the insert developed for the M17 mask.
2. The insert lenses will be one size.

3. The insert design will conform with modern mass production techniques.

4. The manufacture of the insert will be economical.

5. The insert design will keep fitting time to a minimum.

6. The insert will be optically stable when fitted in the mask.

7. The insert will be fabricated from materials identical to those used for the M17 mask insert. These materials will be non-strategic during a national emergency.

8. The insert will require only minor modifications to the mask.

9. The insert will not interfere with the fit of the nose cup in the mask.

10. The insert will fold inside the mask, when the mask is not in use.

11. The mask when equipped with the insert will be comfortable to the wearer.

12. The insert will not interfere with the seal of the mask.

13. The mask when equipped with the insert will not be hazardous to the wearer.

14. The insert will not interfere with correct and rapid donning of the mask.

15. The insert will be capable of rough handling when worn under extreme exercise conditions.

16. The insert will not interfere with low temperature eye lens winterizing outsert.

17. The insert will withstand low temperature conditions when fitted in the mask.

18. The insert will not contact the wearers eyelashes or eyebrows; therefore, during high temperature and high humidity conditions, perspiration by the wearer will not flow into the eyes due to the insert.

19. The insert will be designed to have maximum adjustability.

20. The insert will be of two bridge widths, 22 mm. (narrow) and 26 mm. (wide).

21. The insert will have five horizontal positions: "on line" 3 mm., 6 mm. above, and 3 mm., 6 mm. below on the "on line" position.

22. The insert will have a non-reflective finish,

IV. OPTICAL CHARACTERISTICS

Lens Decentration. The insert may be measured for accurate decentration in the same manner that is used when calculating and accomplishing this procedure in fitting ordinary spectacles. This feature of the insert will eliminate undesirable prismatic effects and spherical aberrations.

Adjustability. The insert can be adjusted up and down away from and close to the eyes, and pantoscopic lens tilting is easily accomplished. The term pantoscopic is used in relation to the reading angle.

Vertex Distance. The vertex distance calculated for ordinary spectacles can be applied in the fitting of this insert. Vertex distance is the measured distance, in millimeters, from the anterior surface of the cornea to the principle refracting surface of the spectacle lens; in strong lens corrections this measurement is a critical consideration in providing maximum visual acuity for the wearer.

Bifocal Lenses. Bifocal corrections can be incorporated in this insert because the design provides the adjustments necessary to obtain the proper bifocal segment height, correct vertex distance, and the required reading angle.

Training Technicians. It will not be difficult to train optical technicians to fit this insert into the E56R3 mask because they can apply the same techniques in measuring and adjusting that they use in fitting ordinary spectacles.

V. CONCLUSIONS

Several prototype models of the optical insert for the E56R3 Tanker's CBR Protective Mask have been designed and fabricated. The optical insert will be available in two bridge widths; 22 mm. (narrow) and 26 mm. (wide). Minor modifications to the mask are necessary to provide a supporting block for the insert. These modifications will make the insert compatible with the mask and will make it possible to provide spectacles for military personnel requiring visual corrections,



<p>ABSTRACT CARD</p> <p>TITLE: Optical Insert, Type 2, Tank CBR Protective Mask (E56R3)</p> <p>AUTHOR(S): COLMAN, Albert B.</p> <p>AGENCY: USA Prosthetics Res. Lab. Walter Reed AMC, Washington 12, D. C.</p> <p>TECH. RPT. 6201</p> <p>Project 6X59-01-001-04</p> <p>ABSTRACT: An optical insert for the Tanker's CBR Protective Mask has been developed which may be fitted to tank crew personnel who require visual correction. It is supported in the mask by insertion of its temporal struts into a series of holes in the two rubber protrusions molded to the inner side of the eyepiece channel of the mask faceblank.</p> <p>WRAMC FORM 0183 (ONE TIME) 15 MAY 1961</p>	<p>AD _____</p> <p>1. Optical Insert, Type 2</p> <p>2. CBR Protective Mask (E56R3)</p> <p>3. Mask (E56R3)</p> <p>4. <u>UNCLASSIFIED</u></p>	<p>ABSTRACT CARD</p> <p>TITLE: Optical Insert, Type 2, Tank CBR Protective Mask (E56R3)</p> <p>AUTHOR(S): COLMAN, Albert B.</p> <p>AGENCY: USA Prosthetics Res. Lab. Walter Reed AMC, Washington 12, D. C.</p> <p>TECH. RPT. 6201</p> <p>Project 6X59-01-001-04</p> <p>ABSTRACT: An optical insert for the Tanker's CBR Protective Mask has been developed which may be fitted to tank crew personnel who require visual correction. It is supported in the mask by insertion of its temporal struts into a series of holes in the two rubber protrusions molded to the inner side of the eyepiece channel of the mask faceblank.</p> <p>WRAMC FORM 0183 (ONE TIME) 15 MAY 1961</p>	<p>AD _____</p> <p>1. Optical Insert, Type 2</p> <p>2. CBR Protective Mask (E56R3)</p> <p>3. Mask (E56R3)</p> <p>4. <u>UNCLASSIFIED</u></p>	<p>ABSTRACT CARD</p> <p>TITLE: Optical Insert, Type 2, Tank CBR Protective Mask (E56R3)</p> <p>AUTHOR(S): COLMAN, Albert B.</p> <p>AGENCY: USA Prosthetics Res. Lab. Walter Reed AMC, Washington 12, D. C.</p> <p>TECH. RPT. 6201</p> <p>Project 6X59-01-001-04</p> <p>ABSTRACT: An optical insert for the Tanker's CBR Protective Mask has been developed which may be fitted to tank crew personnel who require visual correction. It is supported in the mask by insertion of its temporal struts into a series of holes in the two rubber protrusions molded to the inner side of the eyepiece channel of the mask faceblank.</p> <p>WRAMC FORM 0183 (ONE TIME) 15 MAY 1961</p>	<p>AD _____</p> <p>1. Optical Insert, Type 2</p> <p>2. CBR Protective Mask (E56R3)</p> <p>3. Mask (E56R3)</p> <p>4. <u>UNCLASSIFIED</u></p>	<p>ABSTRACT CARD</p> <p>TITLE: Optical Insert, Type 2, Tank CBR Protective Mask (E56R3)</p> <p>AUTHOR(S): COLMAN, Albert B.</p> <p>AGENCY: USA Prosthetics Res. Lab. Walter Reed AMC, Washington 12, D. C.</p> <p>TECH. RPT. 6201</p> <p>Project 6X59-01-001-04</p> <p>ABSTRACT: An optical insert for the Tanker's CBR Protective Mask has been developed which may be fitted to tank crew personnel who require visual correction. It is supported in the mask by insertion of its temporal struts into a series of holes in the two rubber protrusions molded to the inner side of the eyepiece channel of the mask faceblank.</p> <p>WRAMC FORM 0183 (ONE TIME) 15 MAY 1961</p>	<p>AD _____</p> <p>1. Optical Insert, Type 2</p> <p>2. CBR Protective Mask (E56R3)</p> <p>3. Mask (E56R3)</p> <p>4. <u>UNCLASSIFIED</u></p>
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